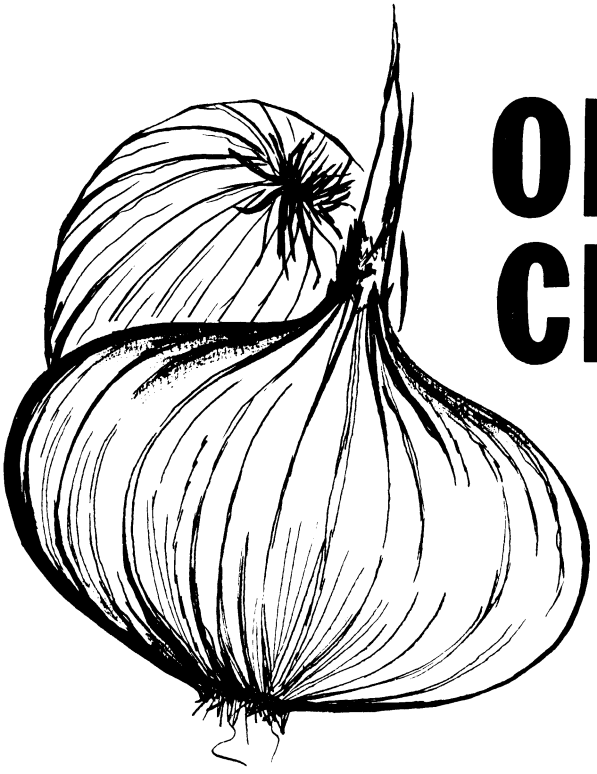
GROWING THE TRANSPLANT



onion crop

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GROWING THE TRANSPLANT ONION CROP [1]

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Growing onions by the transplant method consists in starting the plants in seedbeds and in setting them in the field when they are large enough. The transplant method is now used on about one-third to one-fourth of the onion acreage in the United States.

In the South and Southwest the seed usually is sown in open beds in late summer or early fall. Then by late fall or early winter the seedlings are large enough for transplanting. In the North, however, the seed is sown during February or March in coldframes, hotbeds, or greenhouses. As soon as the weather is warm enough the plants are set in the field. Many northern growers purchase southern-grown transplants.

In the South and Southwest both commercial growers and home gardeners use the transplant method more extensively than elsewhere. In the North, however, commercial growers rarely use transplants but home gardeners do to a considerable extent.

The transplants are not susceptible to smut; and in the North the bulbs usually mature early enough to escape severe injury from thrips.

AREAS PRODUCING THE TRANSPLANT CROP

The States chiefly concerned in growing the commercial transplant onion crop are Texas, Louisiana, California, New Mexico, and Arizona. In Texas it is grown primarily in the irrigated Laredo and Winter Garden districts in the southern part of the State and in the lower Rio Grande Valley. The Laredo district extends as a narrow strip along the Rio Grande in Webb and Zapata Counties; the Winter Garden district includes Zavala, Maverick, Dimmit, La Salle, and Frio Counties, as well as adjoining counties. In northern Texas transplanting without irrigation is practiced around Farmersville, Collin County. In Louisiana most of the commercial crop of onions is grown in the southern part in the Lafourche and the Pointe Coupee-Saint Landry districts. In California the early transplant crop is grown chiefly in the Imperial, Coachella, and upper San Joaquin Valleys, while most of the intermediate crop is grown in the Delta district (the lower San Joaquin and Sacramento Valleys) and to some extent along the coast south of San Francisco.

SOIL REQUIREMENTS

The onion thrives well on slightly acid soil (pH 6 to 6.5), but it grows poorly on very acid soil. To very acid soil add a ton of hydrated lime per acre each year until the acidity of the topsoil is sufficiently reduced.

[1] Original version of this bulletin was written by H. A. Jones, L. R. Hawthorn, and G. N. Davis.

Most of the irrigated soils are alkaline in reaction and do not require liming.

Soils for onions should retain moisture, but they should be well drained. Waterlogged soils should be avoided.

In Texas onions are grown on soils of various types, but the crop is particularly adapted to sandy, silty, and certain clay loams. Many of the sandy loams in the irrigated districts of southwest Texas are fairly shallow and underlain by a rather impervious clay. The sandy loams are ideal for the irrigation of a shallow-rooted crop like onions, as leaching of fertilizer materials is kept to a minimum. The heavier loams require less fertilizer for the production of a good onion crop. However, some difficulty may be experienced at harvesttime, as these soils dry out more slowly. Other conditions being equal, onions will usually mature earlier on the lighter soils than on the heavier and darker silt and clay loams. Onions growing on the lighter soils seem to have more pink root, probably because of higher soil temperatures.

In Louisiana the onions are usually planted on the lighter alluvial soils.

In California the early crop is grown on a variety of mineral soils, but part of the intermediate crop is grown on the peat and muck soils of the Delta district.

FERTILIZATION

The addition of organic matter, either through the use of barnyard manure or by plowing under green manures, improves all mineral soils. In Texas and throughout the Southwest the use of green manure crops is increasing.

Application of manure is important in growing onions on mineral soils, especially those poor in humus. If the manure is not well rotted, it should be applied to the crop preceding the onions. From 15 to 20 tons per acre is considered sufficient. On many soils manure should be supplemented with commercial fertilizers to produce the best results. Where manure is not available, equally good results may be obtained with fertilizers alone. Muck or peat soils do not require additional humus. On these soils it is more economical to supply nitrogen, phosphorus, and potash in chemical fertilizers.

The application of commercial fertilizers is usually profitable irrespective of the soil type. The onion root system is comparatively limited, and the feeding zone is rather restricted. For high yields of onions it is essential to get good top growth before bulb formation begins. The most efficient method is to have equipment that will make the beds and place the fertilizer 3 to 4 inches beneath the row, all in one operation. This method is usually the cheapest and most satisfactory; the yield is usually heavier than where the same amount of fertilizer is applied broadcast or on the shoulder of the bed at the time of transplanting. Sidedressings, even of a balanced, fairly soluble fertilizer, do not equal in value the same material applied to the soil before the crop is set out.

In the Winter Garden and Laredo districts of southern Texas 600 pounds of 6–12–0, 6–18–0, or 5–15–0 fertilizer is needed on silt and clay loams, and 1,000 pounds of one of the above mixtures on sandy loams. Proportionately lower rates are applied if higher grade mixtures such as 16–20–0 and 13–39–0 are used. With the exception of the 16–20–0 fertilizer, all those mentioned have a 1–2–0 or a 1–3–0 ratio. The 1–2–0 ratio fertilizers are better adapted to heavier soils, and the 1–3–0 are better suited to the lighter soils. In other words, silt and clay loams need less phosphoric acid in proportion to nitrogen than the sandy loams. Onions on sand and sandy loams usually show much more re-

sponse to fertilizer applications than those on silt and clay loams. Side dressings of 50 to 75 pounds of sulfate of ammonia per acre are commonly applied, especially in January or February. Such sidedressings are of questionable value except on certain very fine sandy loams adjacent to the Rio Grande or where the crop is showing a noticeable yellowing of foliage due to a lack of nitrogen.

In California onions are grown both on mineral and on peat soils. On most mineral soils it is necessary to add a fertilizer high in nitrogen, and on some it is necessary to add phosphate as well. It is not necessary to add potash to the fertilizer. A general recommendation is to apply 16–20 ammo-phos at the rate of 600 pounds per acre or a 10–10–0 fertilizer at 1,200 pounds per acre. Better yields are obtained on the mineral soils that leach excessively if the nitrogen is derived from ammonia or organic sources rather than nitrate sources. It is often desirable to sidedress these soils with about 50 pounds of nitrogen per acre before the plants start to bulb. For sidedressing, drill sulfate of ammonia or nitrate of soda into the soil or apply anhydrous ammonia gas directly in irrigation water.

On the peat soils of the California Delta district it is necessary to apply a fertilizer containing phosphoric acid and potash. This can usually be supplied by adding 1,000 to 1,500 pounds per acre of 0–10–10 fertilizer. The exact amount of phosphoric acid or potash required will depend largely upon the fertilizer practices of the previous years. Peat soils generally supply enough nitrogen so that it is not necessary to add this element.

In Louisiana 400 to 600 pounds of 4–12–4 fertilizer per acre is applied, well mixed in the row, 10 days to 2 weeks before transplanting. As a rule, a sidedressing of nitrate of soda at the rate of 50 pounds per acre is given when plants are about the size of a lead pencil. A second application at the same rate is given about 4 weeks after the first.

PREPARATION OF THE SOIL BEFORE PLANTING

Preparation of the soil when irrigation is necessary depends upon the system of irrigation to be followed. It is about the same whether seedlings or a transplant crop is to be grown. The land should be thoroughly plowed, disked, and harrowed. If the soil is especially foul with weeds, it will often pay to irrigate the seedbed 2 or 3 weeks before planting time and then kill the crop of weeds that appears by disking and harrowing. The disking should be rather shallow to avoid bringing to the surface too much new seed-laden earth. The soil should be in a well-pulverized condition so that the beds will be free from large lumps.

In many districts in California raised beds similar to those used for growing lettuce and carrots under irrigation are used for the growing of both the seedlings and the bulb crop of onions, especially on the mineral upland soils. For small plantings the beds are usually thrown up with a lister and then shaped with a sled, but for the larger plantings usually both operations are performed at one time. These beds are 30 to 42 inches from center to center and about 6 inches high.

On the peat lands of the Delta district of California the land is plowed, disked, harrowed, and floated. Small irrigation or spud ditches are run through the field at intervals of 80 to 100 feet. The soil from the ditches is leveled so that the land can be planted to the edge of the ditch.

On the uplands in Texas, low ridges are usually made 14 to 20 inches apart; the onion seedlings are planted one row to a ridge. The rows are marked by various means to facilitate uniform spacing. One

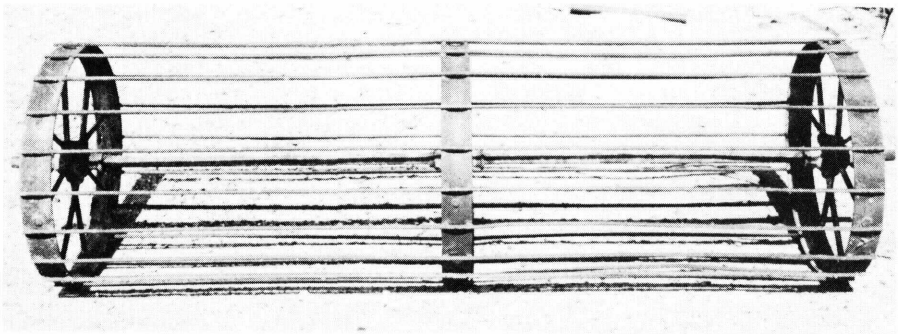

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Figure 1.—This type of marker is rolled over the tops of the beds before planting to mark the place where plants are to be set.

method is to use a lightweight metal (fig. 1) or wooden roller having slats 3½ to 4 inches apart, the distance apart the plants are to be set in the row. On the bottom lands, where the onions are grown in flat beds, or "melgas," between raised borders, very shallow furrows are made about a foot apart to mark the rows.

In certain districts of the Southwest where the border system of irrigation is used, ridges 6 to 8 inches high and 150 to 300 feet long are made 5 to 12 feet apart. These are laid out on the contour of the land, as shown in figure 2, so that the entire area between the borders can be flooded.

GROWING AND HANDLING TRANSPLANTS, OR SEEDLINGS

Growing Transplants for Home Use

If an especially fertile soil can be chosen for the open seedbed in the South, the use of commercial fertilizer will be unnecessary. If a poor soil has to be used or if the onion seedlings grow weakly or have an unhealthy yellowish-green color, a fertilizer application is desirable.

It is important that the seedbed be in an area where the soil is free

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Figure 2.—Irrigating onions on the contour just after transplanting. Eagle Pass, Tex.

from infestation with the pink root fungus. Even if the disease was not observed on the previous crop, it is best to avoid land on which onions have been grown at any time during the previous 4 or 5 years. If pink root occurs in the seedbed, the disease will be carried to the field at transplanting time. And, unless highly resistant varieties are grown, the yields will be reduced.

In the production of transplants the chief object is to produce as many plants as are needed in as small a seedbed as is consistent with the production of healthy, vigorous, pencil-sized plants. Grading plants at transplanting time may be impractical, because of the time and expense involved; therefore, it is important to adjust the rate of seeding so that a maximum number of medium-sized plants will be produced. With heavier rates of seeding, such as 30 to 35 pounds per acre, most of the plants are too small to make good transplants. Over 112,000 plants are required for an acre when plants are set 4 inches apart in 14-inch rows. For any spacing approximating this, it is a common practice to sow 2 pounds of seed for every acre of the transplanted crop, or 20 pounds to the acre. Most growers expect to obtain enough plants from 1 acre of seedbed to set 10 acres.

Some growers use a spreader on the seeding machine to scatter the seed over 2- to 4-inch strips. In these wide rows seeding rates can be higher, but unless the land is practically free from weeds, such rows require much more hand labor. Rows are usually 14 to 16 inches apart (fig. 3).

In southern Texas seedbeds of 5 to 20 acres are not uncommon. The seed of the Bermuda varieties is usually planted from September 15 to 25, whereas that of the Early Grano (Babosa) and related varieties should be sown in early September. In the Collin County district of northern Texas the few growers who raise their own plants usually sow the seed about October 15.

In Louisiana the onion seed is usually drilled in the seedbed from October 1 to 15 in rows 4 to 6 inches apart. The seedbed may be covered with moss or other material that is kept damp until the seedlings are up. At Thibodaux, the seed is planted about 4 inches deep and when it starts to germinate the excess soil is raked off. This deep planting keeps the seed in moist ground, and raking off the excess soil kills the weeds.

In California the seed for the transplant crop is usually planted on raised beds in rows 2 to 8 or even 10 inches apart. On the peat soils of the Delta district rows are spaced close together on the wide

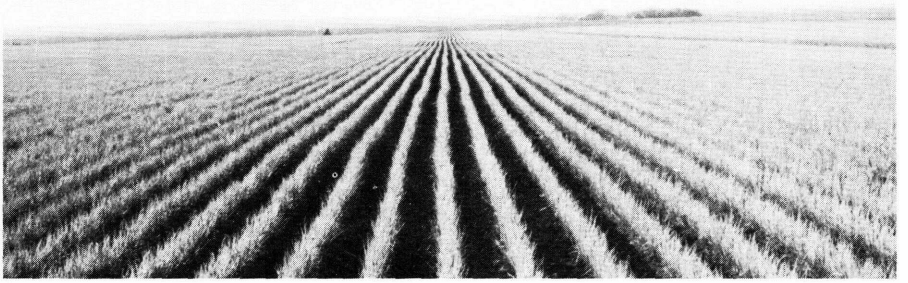

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Figure 3.—Transplants growing in single rows spaced 16 inches apart. Crystal City, Tex.

beds, as many as eight rows being planted on one bed (fig. 4). On sedimentary soils raised beds are generally used, either two or four rows being planted on a bed. Occasionally seed is broadcast in open beds or hotbeds and then raked in. The date of planting depends upon the location within the State, the variety to be used, and the time it is desired to have the crop mature. Seeding is generally done between September 1 and October 1.

In the North the seed is usually sown in coldframes, greenhouses, or hotbeds 10 to 12 weeks before the plants are to be set in the field. Seed is usually sown thinly—10 to 12 seeds to the inch—in rows about 4 inches apart and about half an inch deep. Dusting the seed at time of sowing with some organic mercury compound at the rate recommended by the manufacturer helps to prevent preemergence damping-off and usually increases the number of seedlings. Because of their susceptibility to damping-off, onion seedlings are much more difficult to grow indoors than out in the open; therefore, care must be used in watering. Especially while the plants are small, watering should be avoided during cloudy weather; on bright days it should be done the first thing in the morning so that the soil surface will dry before night. After the first true leaf has appeared, less loss from damping-off occurs.

The best seedlings are produced at cool temperatures. A night temperature of 50° F. and a day temperature of 60° to 65° are satisfactory, but a slightly higher temperature during the day will do no harm on clear days. Plants are set in the field in early spring just as soon as the soil can be worked. If the seedlings are tender, watering them

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Figure 4.—Growing onion seedlings on peat soil in the Delta district of California in closely spaced rows.

less frequently and exposing them to night temperatures of 40° to 45° for a week to 10 days will harden the seedlings somewhat before they are planted.

Growing and Handling Transplants for Shipment

Growing onion plants for shipment is a considerable industry in south Texas, Georgia, and some of the other Southern States. Often growers specialize in this type of business to the exclusion of growing dry bulbs; others conduct both enterprises. Some growers specialize in carlot or truck shipments; others confine their activities to mail-order and express shipments. Although the individual shipments may be small, the total volume of business may be large. Growers catering to small orders for home gardeners often ship onion plants 8 months in the year and plant and have seedbeds 10 months. Shipments go to every State in the Union, as well as to Canada and Cuba. Peak shipments of onion plants come in late winter or early spring, when the northern demand is greatest.

The chief problem of the onion-plant grower who caters to a year-round business is to estimate the demand for the different months and to have the right number of plants available at the proper time. He must know the approximate time needed to grow a transplant crop at the different seasons of the year. Seed planted toward the end of September in south Texas will produce good transplants in late November or early December, while seed planted toward the end of October may not produce seedlings ready for pulling until late January or early February. Growers become adept in timing irrigations to speed up or slow down the growth rate of the seedlings, so that they will be available at the right time for planting in the various districts.

As the plants are often in transit for a week or more, they must be handled so as to prevent decay. They are pulled and tied in bundles; the roots and tops are trimmed; and the plants are packed upright in dry, well-aerated, flat crates for shipment (fig. 5).

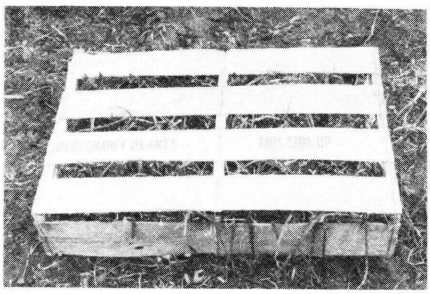

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Figure 5.—Type of crate used to ship onion transplants.

TRANSPLANTING

Healthy, vigorous seedlings about one-fourth to five-sixteenths inch in diameter at the neck and about 7 to 13 inches in height before pruning are best for transplanting. Very small plants should be discarded, as they are consistently less productive than medium-sized plants. Large plants produce higher total yields than either small or medium-sized ones. However, the marketable yields from large plants may be reduced by the presence of a large proportion of splits, doubles, and bolters—all cull grades.

When seedlings have reached the proper size they should, as a rule, be transplanted. In California yields from early plantings with the intermediate crop are the heaviest; in general, as the transplanting date is delayed the yields are smaller. Usually, seedlings make very little growth aboveground during the winter in central California, southern Nevada, southern Utah, and other places with a similar climate, but conditions are

usually favorable for root development. Plants set early develop extensive root systems during the winter, so that they grow rapidly when the weather becomes warm in the early spring. Onion plants start to bulb under conditions of temperature and length of day specific for the variety. Usually when environmental conditions become favorable for bulbing, the larger plants will produce the larger bulbs. Therefore, conditions that help to produce large plants also help to increase the size of the bulbs and consequently the yield per acre.

The seedlings may be plowed out, but a common procedure is to irrigate the seedbed in advance, so that they can be easily lifted without plowing. When a worker has accumulated a handful of plants, he removes part of the tops with a knife or by a quick twist of the hand. If the roots are long they also are trimmed by shears, whole bunches being clipped at one time. The pruned seedlings are about 5 to 6 inches long (fig. 6). A considerable reduction in yield of bulbs occurs when both tops and roots are pruned. The only advantage is that pruning facilitates transplanting.

In the South and Southwest the plants are usually ready to be set 8 to 10 weeks after seeding. Early Grano and Granex usually grow somewhat faster than the Bermuda types and therefore reach transplanting size somewhat sooner.

In Texas transplanting is usually

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Figure 6.—Pulling plants for transplanting in southern Texas.

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Figure 7.—Method of scattering the transplants ahead of the planters.

done during November and December, but it may extend into early January or even later. The seedlings are pulled, pruned, and placed in baskets or crates; then they are distributed ahead of the planter along 2 or 3 rows at a time, as shown in figure 7. All transplanting is done by hand, and the seedlings are set a uniform distance apart (fig 8). A short stick, or dibble, is used by most workers to make a hole and to press the soil around the plant. Experienced planters can scatter and set as much as one-third acre (37,000 plants) a day, but the average planter usually sets about one-fifth to one-fourth acre. Most of the planting is done by contract, the workers being paid by the number of acre rows (rows 210 feet long) set.

In California the seedlings are transplanted in late November, December, and January. By the use of a small plow a furrow slice is thrown away from each side of the raised bed at the top. The seedlings are laid against the side of the furrow, about 3 inches apart and at an angle of about 45°, with the tops

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Figure 8.—Cross marks on ridges are made to insure accurate spacing of the plants.

toward the center of the bed. The roots are then covered, a lister or cultivator being used. If necessary, water is run between the beds to settle the soil around the roots. The plants are set so that the rows will be 8 to 10 inches apart on the bed and the plants within the row a uniform distance apart to facilitate cultivation.

On the peat soils of the California Delta district the intermediate crop is set on the level. The rows are spaced about 10 inches apart, and the plants are set 3 inches apart in the row. A hand cultivator with two plows attached is used for planting (fig. 9, *A*). The right plow covers the plants that have just been set, while the left one opens the furrow for the next row. Here, too, the seedlings are laid against the side of the furrow in a slanting position (fig. 9, *B*), but they gradually grow erect so that there is no interference with cultivation. As the soil is usually moist during the transplanting season there is no need for irrigation.

In Louisiana plants are set in the field between December 20 and January 15. They are set about 4 inches apart in single rows on raised beds that are about 3½ feet apart. Raised beds are used to provide drainage. In the center of the ridge, holes are made into which the seedlings are dropped; then the soil is firmed about them.

IRRIGATION

The frequency and the amount of irrigation required depend on so many variable factors, such as type of soil, amount of rainfall, condition of crop, variety, and presence of diseases, that it is difficult to give definite recommendations. Most of these factors vary from year to year and from farm to farm. If the soil is dry, onions should be irrigated as soon as possible after they have been set (fig. 10).

Many growers delay irrigating too long; some delay it intentionally, with the idea that such procedure is beneficial. Although onion seedlings will survive 12 days or more after being transplanted to a very dry soil, delaying irrigation always results in lower yields. Roots continue to arise from the stem plate at the base of the onion plant during most of the time that the plants are growing. New roots are not formed unless the zone from which they arise is in moist earth; therefore, the soil near the surface must be kept moist until the crop is nearly mature.

Most of the transplant crop of the Southwest and West is irrigated during part or all of the growing season. Onions must be kept growing steadily without any setbacks, as those that start new growth after being retarded may split or double and thus produce a smaller yield of U. S. No. 1 bulbs.

Overirrigation, as well as lack of water, may cause reduction in yields. The foliage on onions receiving excessive irrigation acquires a somewhat unhealthy yellowish-green color. If the soil rarely gets dry, it probably is overirrigated. Onions that receive just enough water will often yield as well as or better than those growing in soil that is continuously moist or wet on the surface. On the other hand, it is difficult to determine when a soil has been receiving too little irrigation, as the crop appears healthy and vigorous.

When the plants start to mature, irrigation should be discontinued and the soil allowed to dry out as much as possible; otherwise, a second root growth, which is difficult to stop, may start and complicate the process of curing the onions properly.

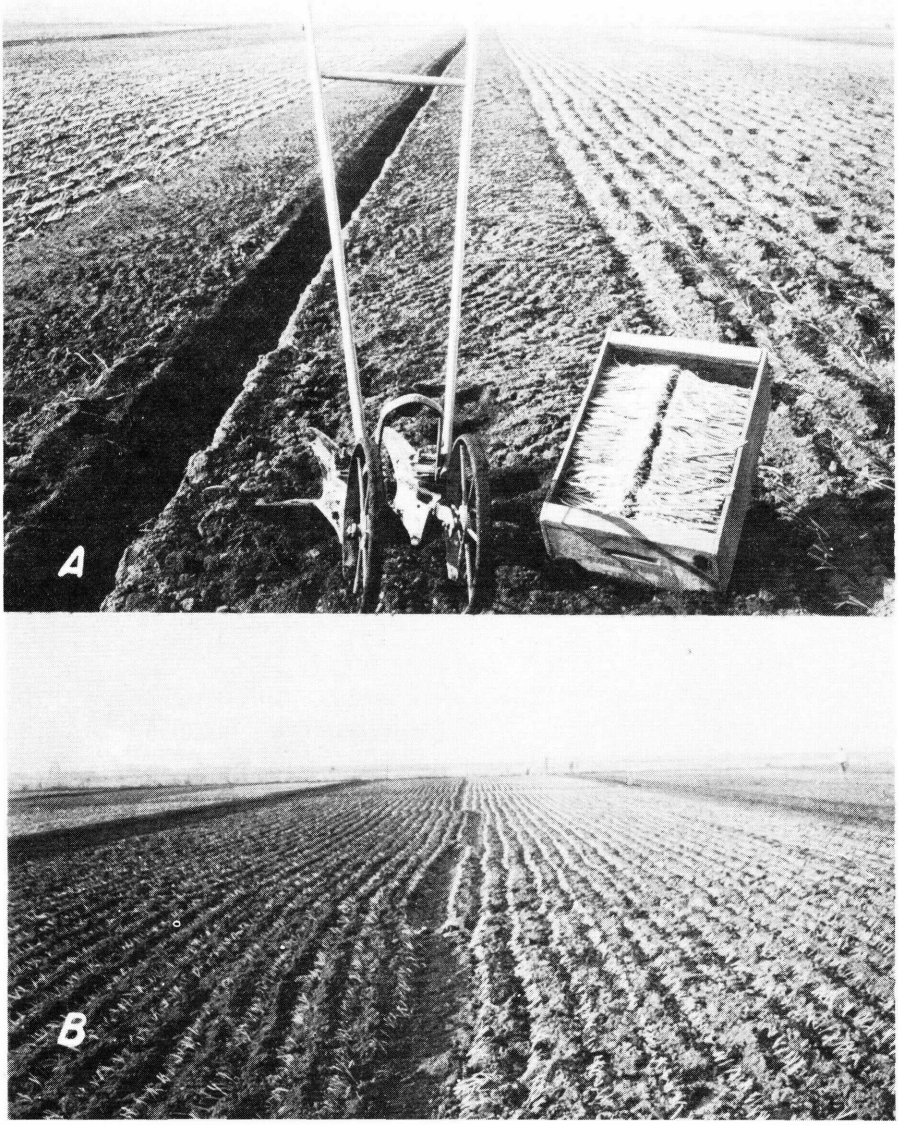

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Figure 9.—Transplanted onion seedlings on peat land in the Delta district of California. *A*, The right plow of the cultivator covers the seedlings that have just been set and the left plow opens a new furrow. The seedlings in the box show the method of pruning generally used. *B*, Seedlings are laid in a slanting position against the side of the furrow and then covered.

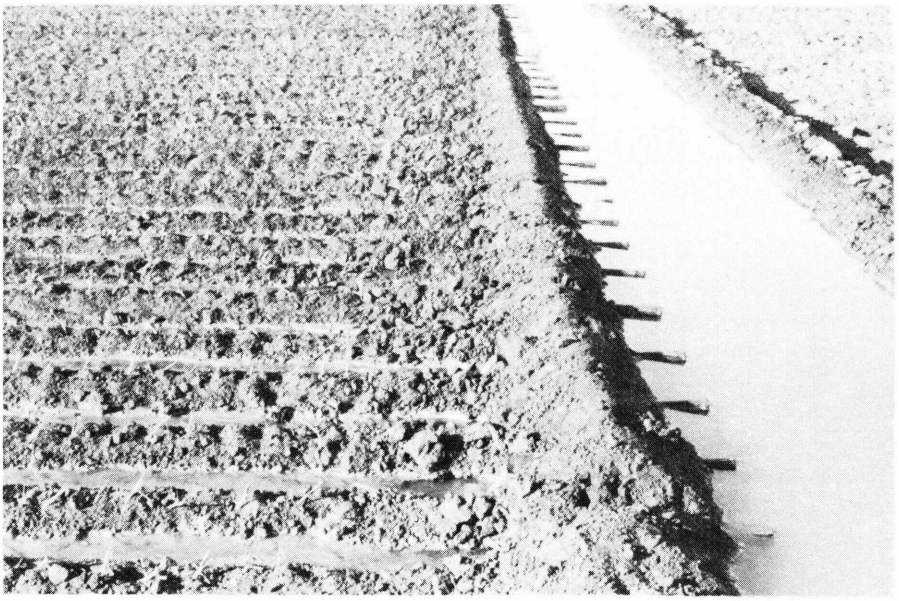

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Figure 10.—The first irrigation after transplanting in the Winter Garden district of southern Texas: Various types of conduits are used to take the water from the irrigation ditch to the furrows between the onion rows.

On the sandy loams of southwest Texas 5 to 8 irrigations usually are required between transplanting and harvesting. From December to early March irrigations can be 6 to 10 weeks apart, but beginning in March the frequency must usually be increased to once every 5 to 14 days. In south Texas strong winds prevalent at this time increase the water requirement.

On the peat lands of the California Delta district the surface of the onion land is usually below that of the water in the streams. Irrigation is carried on by siphoning and pumping the water from the rivers and network of waterways that surround the islands into large ditches that carry it to a system of laterals extending through the fields. The soil is open and porous; and when the water is raised in the ditches, the water table is elevated throughout the entire soil area. The water is raised to within a few inches of the surface and is then pumped back into the river until the water level reaches the desired depth. Overhead irrigation with sprinkler systems is gaining favor in California.

WEED CONTROL

By Cultivation

Weed control is essential both in the seedbed and in the field, as onions must be kept free from weeds to produce maximum crops. All cultivations should be shallow, as the small feeder roots of onion plants are near the surface. The crop is usually cultivated after a heavy rain and in irrigated districts after each irrigation. This controls weeds, prevents crusting of the soil, and facilitates the penetration of water at the next irrigation. Need of additional cultivations depends on the growth of weeds between irrigations or rains. Cultivation should be discontinued if too much injury to the onion tops occurs.

Light tractors with attached cultivator equipment are commonly used to cultivate several rows simultaneously. As a rule, cultivation must be supplemented by hand weeding both in the seedbed and in the field. Hand weeding is slow and tedious. In Texas weeding is often done by contract at so much an acre, the price depending on the condition of the field. When an agreement has been reached, the contractor hires a sufficient number of workers and does the job as quickly as possible.

By Chemical Sprays and Burning [2]

The control of weeds represents one of the major costs of growing a crop of onions. The general practice in most districts for most seedbeds and fields is to remove weeds by cultivation and hand hoeing. In recent years, however, great strides have been made in reducing the cost of weeding by use of chemicals. It is now possible, at least in some districts, to grow the transplant onion crop with little or no hand weeding or cultivation.

Preemergence treatment. — The control of weeds in the nursery or seedbed is the grower's first consideration. Generally, the first weeds are from seeds that germinate more rapidly than those of onions and appear before the onion plants emerge. These weeds may be killed by any of the following applications: A light aromatic oil at 40 to 80 gallons per acre; a 3- to 5-percent solution of sulfuric acid in water at 100 gallons per acre; isopropyl N-(3-chlorophenyl) carbamate (CIPC) at 2 to 8 pounds per acre when weeds are in the seedling stage but before emergence of onions. Combinations of CIPC and light aromatic oils control smartweed and purslane effectively.

Burning the top of the seedbed after the first weeds appear is practiced in some districts. Special burners utilizing butane or other suitable fuel have been constructed on sleds that are dragged over the seedbeds.

Postemergence treatment (young seedlings).—Weeds can be controlled successfully when the onion plants are in the young seedling or loop stage (first true leaf is 2 to 3 inches long) by use of a 2- to 3-percent sulfuric acid solution in water at 100 gallons per acre or with potassium cyanate (KOCN) at 10 to 16 pounds in 50 to 100 gallons of water per acre.

Most annual weeds in onions in the 5-leaf stage or older can be controlled by using CIPC at 2 to 8 pounds, KOCN at 16 to 20 pounds, or monuron at 2 pounds in 20 to 40 gallons of water per acre or a 3- to 4-percent solution of sulfuric acid in water at 100 gallons per acre and applying the solution as a basal-directed spray. In spraying, avoid hitting tops of onion plants.

Precautions.—*When mixing sulfuric acid and water always pour the acid into the water and never pour water into the concentrated acid.* Mixing should be done in a crock or wood container before putting it into the spray tank. The 4-percent spray can destroy cotton, silk, and rayon clothing, but it is not harmful to the skin. It is a good practice to have a supply of fresh water handy in case some of the concentrated acid gets on the operator. Sulfuric acid is corrosive to most metals, thus it should never be left in the sprayer. It is advisable to pump fresh water through the sprayer followed by a neutralizing solution after each day's use. Galvanized or zinc containers should never be used, since the acid is very active on these metals; the reaction will weaken the spray concentration and damage the containers.

[2] The information in this section was supplied by the Weed Control in Crops Section of the Crops Research Division, ARS.

The effectiveness of an herbicide is influenced by soil type, temperature, rainfall, and other soil and climatic conditions. For this reason, weed control practices may vary in different districts and on different soil types in the same district. It is therefore advisable to get the most up-to-date information from the State agricultural experiment station, the extension service, or your local county agent.

In many districts commercial spray companies, familiar with local recommendations and possessing all necessary spray equipment, can be hired to do the spraying.

DISEASES AND INSECTS

Diseases [3] and insects are not such a factor in growing the transplant onion crop as in growing onions from seed. Only pink root and thrips need particular discussion in this bulletin.

Pink Root

Pink root [4] is the most prevalent and most destructive disease found throughout the South and West where the transplant crop is grown commercially.

Pink root symptoms are rather easy to identify. As the name indicates, the roots are the organs chiefly attacked; these shrivel and die and take on a distinctly pinkish color. Symptoms may appear on the roots of the very young seedlings; and, as the plant develops and sends out new roots, they in turn become diseased and functionless. As a rule, the plants are not killed by the disease. Bulbs may not form or may remain small and yields are greatly reduced when the root system is severely injured. The tips of the leaves often wither and die, making them susceptible to various fungus leaf blights.

Injury increases on succeeding crops of onions, and damage becomes more and more pronounced. During the cool winter months damage is usually not severe, but as the temperature becomes higher in the spring the causal fungus becomes increasingly active.

The control of pink root is a very difficult problem, once the soil becomes infested. The only practical control is to use a long rotation and plant resistant varieties. Other crops should be planted for a period of 3 years or longer.

If possible, the seedbed should be located on soil free from infestation with the pink root fungus, preferably on land that has not grown onions previously. This is a very important consideration, as seedlings with diseased roots will inoculate the soil wherever they are transplanted. The varieties Excel, L 36, Eclipse, Early Crystal 281, and Texas Hybrid 28 are all highly resistant to pink root and will make good yields on soils highly infested with this fungus.

The Grano types, L 690, and Creole are very susceptible and should not be planted on infested soil. Yellow Bermuda is somewhat resistant but suffers severely on badly infested soil.

Thrips

The onion thrips [5] is the most destructive insect on the transplant onion crop. The amount of damage varies from season to season, but some injury occurs practically every year in many districts. In the South thrips live on the onion crop throughout the winter. In the North onion thrips pass the winter on bulbs in storage, on onion plants that survive in the field, on such

[3] Diseases are discussed in U. S. Department of Agriculture Farmers' Bulletin 1060, "Onion Diseases and Their Control."

[4] Caused by the soil-inhabiting fungus *Pyrenochaeta terrestris* (Hansen) Gorenz, Walker, & Larson; formerly called *Phoma terrestris* Hansen.

[5] *Thrips tabaci* Lind.

hardy plants as alfalfa and red clover, and in grass sod.

The female lays her small whitish eggs in the tissue of the onion leaf. Under high-temperature conditions the eggs hatch in about 5 days; under cool conditions it takes somewhat longer. The small white larvae feed on the center leaves, where the tissue is tender and the larvae are well protected. In about 5 days the larvae attain full size, leave the plants, and drop to the soil, where pupation occurs. The pupal stage lasts about 4 days under warm temperature conditions and somewhat longer under cool conditions. Thus, a complete generation extends over about 2 weeks, depending upon the temperature. If the growing season is warm more generations will occur than if the season is cool.

Environmental conditions during certain seasons may hold thrips damage to a minimum. Cool weather reduces the number of generations; hard, driving rains wash the thrips from the plants and destroy many of them; and predatory insects also aid in reducing infestations.

Thrips also may be controlled by applying insecticides.[6] These are available from dealers as dusts, ready for use, and as emulsifiable concentrates and wettable powders, which can be mixed with water and applied as sprays. Dusts can be applied with suitable hand or power equipment or by aircraft (fig. 11).

The following dusts should be used at the rate of 30 pounds per acre: 10-percent DDT; 20-percent toxaphene; 5-percent malathion; 2½-percent heptachlor; 1½-percent dieldrin; or 2-percent parathion.

If a spray is to be used, the following amounts of insecticide should be applied per acre: DDT, 1½ pounds; dieldrin, ½ pound; heptachlor, ½ pound; toxaphene, 2 pounds; malathion, ¾ pound; or parathion, ¼ pound. If a high-gallonage sprayer is used, the insecticide should be in the form of an emulsifiable concentrate or a wettable powder. If a mist blower or low-gallonage sprayer is used, an emulsifiable concentrate should be used. A high-gallonage sprayer applies 100 to 150 gallons per acre; a low-gallonage, 25 to 50 gallons; and a mist-blower, 5 to 10 gallons.

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Figure 11.—Dusting onion nursery by airplane for the control of thrips. Crystal City, Tex.

Most insecticides are poisonous. Handle them with care. Store them in closed containers so that they cannot be mistaken for food or medicine. Put them out of reach of children and farm animals. Make sure the containers are properly labeled.

Parathion is particularly poisonous and should be applied only by or under the supervision of a trained operator, who will assume full responsibility for its application and enforce the precautions prescribed by the manufacturer. It is extremely toxic if swallowed, inhaled, or absorbed through the skin; it may cause death. Do not attempt to prepare parathion dusts, but use them ready-mixed.

[6] Control measures were obtained from U. S. Department of Agriculture Leaflet 372, "The Onion Thrips, How To Control It," issued 1954.

Do not apply parathion to bulb onions within 21 days of harvest, or dieldrin within 14 days of harvest.

BOLTING

In practically all the districts where the transplant crop is overwintered, a high percentage of the plants may bolt; that is, they may produce seedstalks. As a rule, these plants are not marketable and therefore represent a loss. The amount of bolting is caused by a number of different factors. Certain varieties tend to bolt much more readily than others. Sweet Spanish, White Sweet Spanish, Crystal Wax, Yellow Bermuda, Excel, L 690, L 36, Eclipse, Granex, White Granex, White Creole, and Red Creole bolt rather readily; Red 21 (California Early Red), Calred, Stockton G36, Stockton Yellow Globe, Early Grano, Texas Early Grano 502, San Joaquin, Early Crystal 281, and Italian Red do not bolt so readily. The size of the overwintered plant also plays a very important part, as large seedlings bolt much more readily than small ones.

Temperature also is important in determining the amount of bolting. The highest percentage of bolting occurs after a warm late fall and a cold late spring. A warm fall favors the development of a large plant for overwintering, and the combination of a large plant and a cool spring provides ideal conditions for bolting. Conversely, the fewest bolters occur after a cool fall and a warm spring. The effect of a difference of a few degrees in temperature on bolting is often evident in commercial fields. In districts where two rows of transplants are grown on raised beds running east and west, the north row frequently has more bolters than the south. The north side of the bed is cooler because it does not get the direct rays of the sun and in addition is shaded by the south row. More bolting occurs on heavy than on light soils, and usually there are more bolters in low spots in the field that remain moist than in well-drained parts. In south Texas a few days' delay in time of seeding in the nursery or in transplanting will often reduce considerably the amount of bolting.

As hybrids usually produce large seedlings early, it is often advisable to plant hybrid seed in the seedbed later than the standard varieties to avoid overwintering too large a plant.

HARVESTING AND CURING

The market price, the condition of the crop, the weather, and the inclination of the grower all help to determine the actual date when harvesting of onions is to begin. In general, growers start to harvest when 30 to 50 percent of the tops have fallen over. In most districts the tendency is to pull the crop when the bulbs have reached about their maximum size but while the tops are still green. Most commercial growers do not wait for the crop to mature fully. Studies in Texas and California, however, show that yields continue to increase until most of the tops have fallen over or at least have softened at the neck. Bulbs harvested when somewhat immature retain their outer scales better after harvest.

If necessary the onions can be plowed out to facilitate harvesting. When four, six, or more rows are marked at a time in planting, they can be plowed simultaneously at harvest by adjusting the same equipment. To cut the roots of onions grown on raised beds, some growers use a subsurface knife fastened horizontally between two boards and pulled by a team or a

tractor. Roots are cut several inches below the bulb. If the onions are somewhat immature, they can be left standing in the row and allowed to ripen for a week or two. This system works particularly well with the Early Grano variety, which usually ripens more slowly than the Bermudas because of its heavy foliage. The last irrigation, however, often leaves the soil sufficiently soft for the onions to be pulled without being plowed.

As the onions are pulled, they may be thrown into windrows and allowed to cure; or the tops and roots may be clipped off immediately and the bulbs left in the windrow to dry (fig. 12) or placed in crates, baskets (fig. 13), or other containers. The length of curing depends on the maturity of the crop and the atmospheric conditions. If the onions are fairly mature, the humidity low, and the air movement good, it is not unusual to pull, clip, and ship the same day. If the crop is windrowed in hot, sunny weather, the bulbs should be protected by overlapping tops to prevent sunscald. The tops are clipped to leave a short neck; it is undesirable to cut too close to the bulb, as a large open wound does not dry well and decay organisms may enter. The roots are trimmed close to the base of the bulb.

Harvesting, like planting, is usually done on contract, the workers receiving a fixed amount per bushel of onions pulled, clipped, or hauled, as the case may be. The crew that sorts the bulbs into the various sizes and grades usually works by the hour or day.

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Figure 12.—Granex onions being pulled and clipped and left in the windrows to dry. Crystal City, Tex.

GRADING AND LOADING

In south Texas the cured onions are usually hauled to central packing sheds, where they are run over graders to sort out the jumbos and those of small size. Most of the crop is sold in open-mesh 50-pound sacks. These provide good aeration and make an attractive package. Refrigeration cars are used for

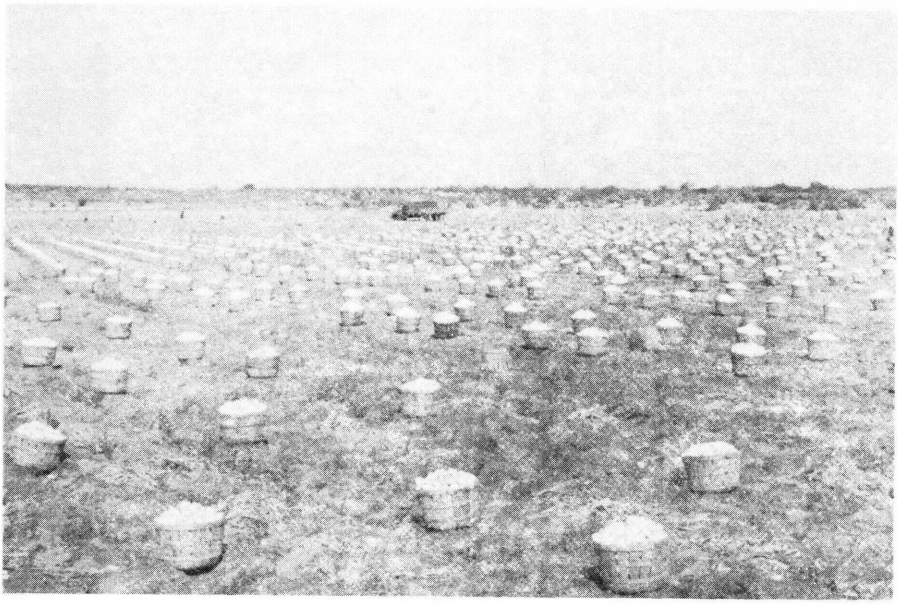

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Figure 13.—Bermuda onions curing in baskets in the field. Laredo, Tex.

shipping. Usually 510 50-pound sacks are loaded in a car. (For method of loading, see fig. 14.) Figure 15 shows a loaded car ready for shipment.

When Bermudas are sold to truckers directly from the field, they are often not run over the grader but are given a so-called polishing. This consists in dumping a bushel of onions onto a burlap sheet. This sheet is then lifted from the ground by two laborers who hold the corners. By raising and lowering opposite sides of the burlap, the onions are rolled back and forth to loosen the scales and rub off the soil.

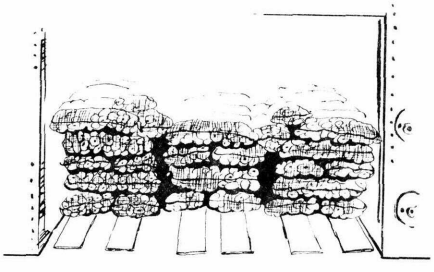

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Figure 14.—Method of loading refrigerator cars with 510 50-pound bags of onions. The bottom layer is placed on excelsior pads. Note ventilation channels between stacks and car wall of first 4 layers.

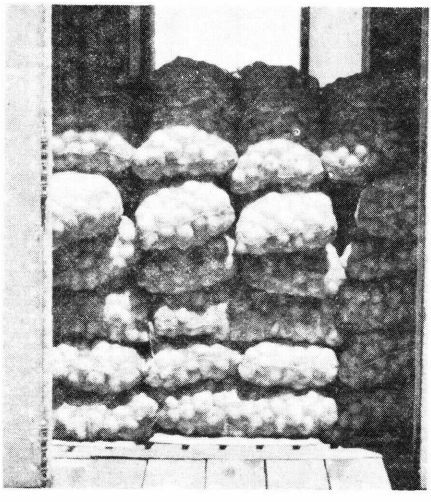

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Figure 15.—Excel onions in 50-pound open-mesh bags, loaded for shipment in refrigerator car. Laredo, Tex.

STORAGE

Red Creole and White Creole store best and Italian Red stores the poorest of the onion varieties generally used for the transplant crop. Early varieties like Excel, L 36, Eclipse, Granex, White Granex, Texas Hybrid 28, Texas Early Grano 502, and Early Crystal 281 can be held for 3 or 4 months if well cured and stored under dry well-ventilated conditions or put into cold storage. Bulbs store best if they are pulled about the time the tops fall over. The onions should be dried as rapidly as possible. The neck tissue should be thoroughly dry before storage. The bulbs should then be stored in a dry room that has a good circulation of air.

VARIETAL DESCRIPTIONS

All the onion varieties described herein can be used as transplants. The varieties are grouped into three categories: Early, intermediate, and late. The early varieties are those that are usually grown as winter crop in the South and mature in early spring. The late varieties are those that need long hours of daylight to mature properly and are therefore best adapted to the North. Intermediate varieties are those that fit in between.

Early Varieties

Crystal Wax.—This variety is adapted to the South and Southwest, where it is grown as a winter crop. In south Texas and in California, where seed is sown in mid-September and the seedlings are transplanted to the fields in November and December, the bulbs usually mature in April and May. Crystal Wax is not adapted to the Northern States when grown from seed in the field; but, when it is seeded in the greenhouse in December or January and the plants are set in the field in early spring, maturity is reached in June, July, or later, depending on the district. Crystal Wax bolts rather readily. Seedlings are grown in the South for shipping and planting in the North. Crystal Wax is also grown extensively as a green bunch onion. When grown under irrigation in the South and Southwest, the majority of the bulbs attain a diameter of 3 to 3½ inches. The bulbs are flat and have very thin, shiny, dry, white scales that are soon broken and lost in handling. The flesh is soft and very mild in flavor. In the early districts of the South it has been almost entirely replaced by new introductions.

Early Crystal 281.—This variety was developed and introduced cooperatively by the Texas Agricultural Experiment Station and the United States Department of Agriculture and released to growers in 1955. It is a Crystal Wax type onion about 10 days earlier than Eclipse and is less subject to splitting and bolting than Eclipse. Early Crystal 281 is somewhat less productive than Eclipse and is slightly more pungent. It is resistant to pink root. It will probably be used as an extra early onion in the southern districts. The bulb type is shown in figure 16.

Eclipse.—This variety was developed and introduced cooperatively by the United States Department of Agriculture and the Texas Agricultural Experiment Station. It is adapted to the southernmost part of the United States where it is grown as a winter crop. The bulb is medium to large in size, white, flat, attractive, and mild in flavor. It is highly resistant to pink root and keeps well if properly cured and stored under good aeration. Figure 17 shows this variety growing in soil heavily infested with the pink root fungus.

Excel.—This variety is a single-plant selection from Yellow Bermuda, developed and introduced in 1945 cooperatively by the United States Department of Agriculture and the Texas and California Agricultural Experiment Stations. Excel is adapted to the South and Southwest, where it is grown as a winter crop. In most plant characteristics it is similar to Yellow Bermuda. Excel does not bolt so readily as Yellow Bermuda when the varieties are planted at the same time. Excel is resistant to pink root. The bulbs mature about 10 to 14 days earlier than those of Yellow Bermuda. Because of the early-maturing habit, the bulbs do not reach sufficient size in the North; therefore, Excel cannot be recommended for the transplant crop there. The bulbs are a little thicker than those of Yellow Bermuda, free of pink flesh, and practically free of doubles and splits. The Excel variety should be harvested a little on the green side and precautions taken to avoid sunscald. In the early districts of the South it outyields Yellow Bermuda. The flesh of Excel is crisp and mild in flavor; these qualities make it a good salad onion.

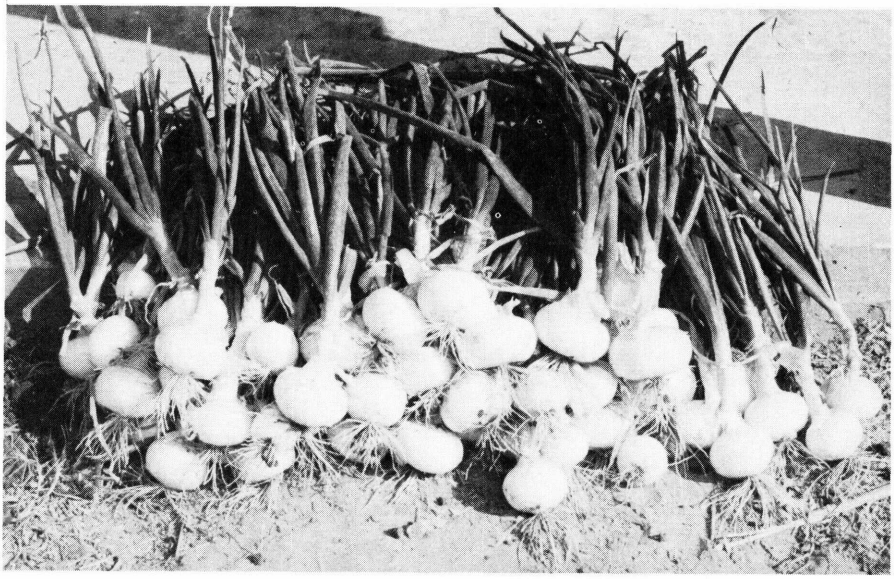

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Figure 16.—Early Crystal 281, an extra early onion adapted to the extreme South.

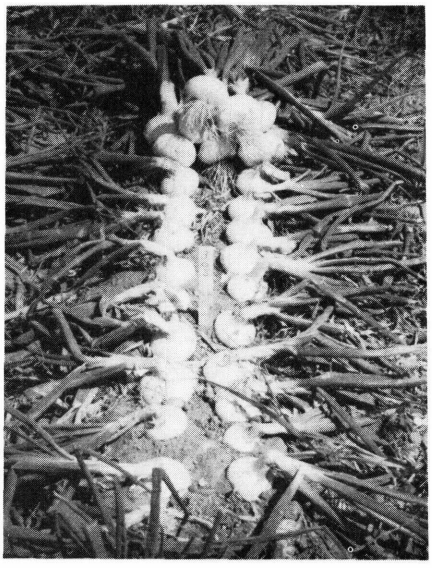

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Figure 17.—Eclipse growing in southern Texas in soil heavily infested with the pink root fungus.

Granex.—This is a true F_1 hybrid developed and introduced cooperatively by the United States Department of Agriculture and the Texas Agricultural Experiment Station. It is adapted to the southernmost part of the United States where it is grown as a winter crop. Young seedlings are very vigorous and survive under rather adverse conditions. Because of its extreme earliness, Granex should not be used as a transplant in the North. The yellow bulb is large and exceptionally mild. In general, this bulb is thick-flat in shape, but varies with the type of culture. The typical bulb shape is shown in figure 18. When grown on raised beds the bulb becomes somewhat flattened, but if it is planted on the level and soil is pulled to the row the bulb becomes thicker. Because of its early rapid growth Granex should be seeded and transplanted later than varieties like Excel or L 36; otherwise, too large a plant will be overwintered and excessive splitting and bolting will result. Highly infested pink root soil should be avoided.

L 36.—This variety was developed and introduced cooperatively by the Texas Agricultural Experiment Station and the United States Department of Agriculture. It is adapted to the southermost part of the United States, especially in southern Texas and the Imperial Valley of California where it is grown as a winter crop. It is too early maturing to be used as a transplant crop in the North. L 36 makes a very attractive yellow flat bulb of medium size and is very mild in flavor. It is an excellent keeper. It is very firm and makes the most attractive pack of any of the Yellow Bermuda types.

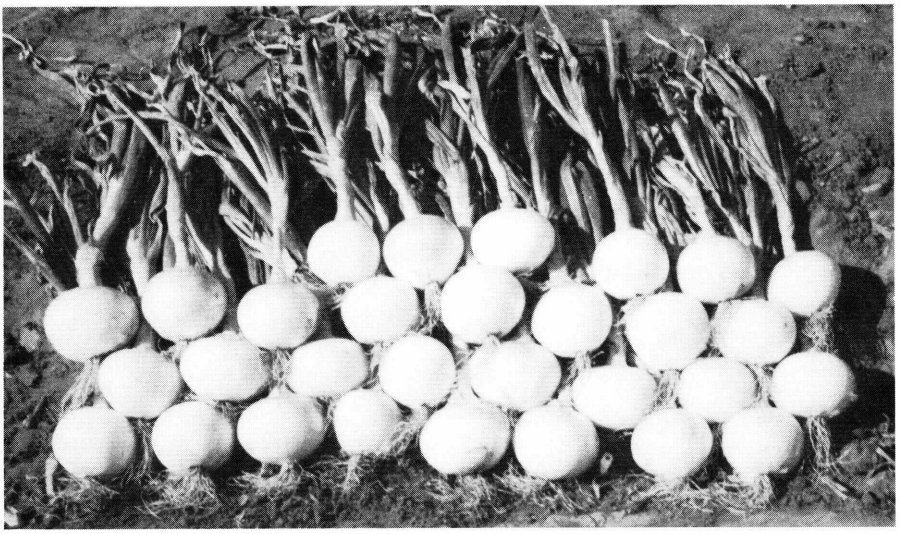

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Figure 18.—Granex, an F_1 hybrid, is an extra early heavy-yielding onion, the first of the southern onions to appear on the market in the early spring.

L 690.—This variety was developed and introduced cooperatively by the United States Department of Agriculture and the Texas Agricultural Experiment Station. It has been largely replaced in south Texas by Eclipse and other recent introductions. L 690 is subject to splitting and bolting and is susceptible to pink root. It does, however, make a very attractive pack. It also is used to a considerable extent as a green bunch onion. Certain growers who have learned how to handle L 690 use it on the lighter soils along the Rio Grande.

Red Creole.—Red Creole seems to be fairly well adapted to the southermost districts of the Southeast and along the coast as far north as Charleston, S. C. At present it is of commercial importance only in southern Louisiana, where it is the chief variety for home and market purposes, as it keeps better in open sheds or barns during the humid summer than any other variety. In southern Louisiana the bulbs reach a diameter of 2 to 2½ inches. They are flat to medium-oblate in general shape. The upper half is slightly rounded to slightly tapered; the lower half is flat to slightly rounded. The outer dry scales are retained fairly well in handling and storage. They are dull buff red on the lower half, with more buff in the veins and on the upper half toward the neck; dry scales become more dull and more buff with age. The bulbs have a high dry-matter content and are very pungent and firm in texture. Red Creole is susceptible to pink root but rather resistant to purple blotch.

Texas Early Grano 502.—This variety was developed and introduced by the Texas Agricultural Experiment Station. It was developed by selecting early-maturing bulbs in a field of commercial Early Grano near Winter Haven, Tex. It is adapted to the South and Southwest, where it is grown as a winter crop. It is the earliest maturing of the Grano types. In general, its characteristics are similar to those of Early Grano except that it is more uniform and earlier maturing. The typical shape is shown in figure 19. Texas Early Grano 502 bolts less readily than Yellow Bermuda and is somewhat resistant to thrips, but very susceptible to pink root. It is a heavy yielder.

Texas Hybrid 28.—This is a true F_1 hybrid between Excel used as the seed parent and Eclipse used as the pollen parent. Texas Hybrid 28 is very similar to Excel, except that it is slightly lighter yellow in color and a little heavier yielding. It is highly resistant to pink root.

White Creole.—Same as Red Creole except for being white.

White Granex.—This is a true F_1 hybrid developed and introduced cooperatively by the United States Department of Agriculture and the Texas Agricultural Experiment Station. White Granex is very similar to Granex except for color and slightly later maturity. It yields about the same as Granex, is exceptionally mild, and can be kept for several months if well

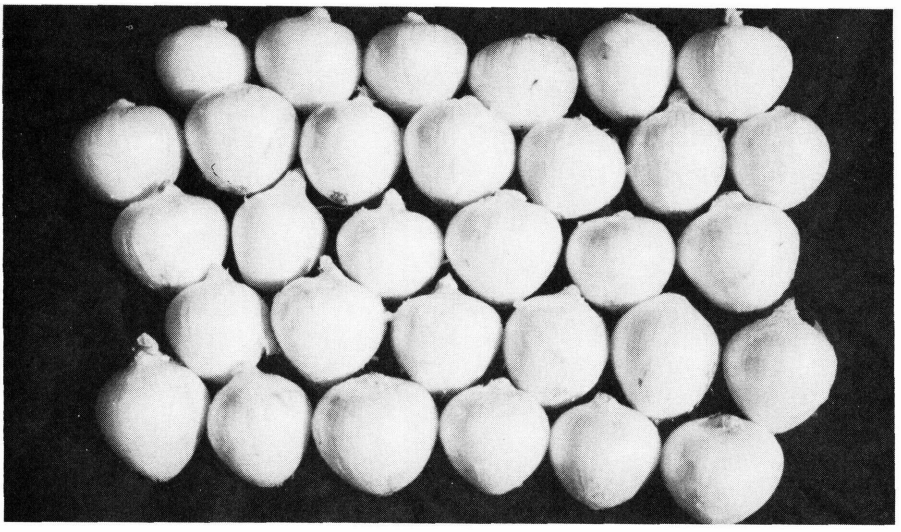

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Figure 19.—Texas Early Grano 502, an early variety grown extensively in the Winter Garden district of Texas.

cured and stored under dry well-aerated conditions. Highly infested pink root soil should be avoided.

Yellow Bermuda.—This variety is adapted to the South and the Southwest, where it is grown as a winter crop. In south Texas and California, where it is seeded in mid-September and the seedlings are transplanted to the field in November or December, the bulbs usually mature in April and May. Yellow Bermuda is not adapted to the Northern States when seeded in the field. When it is seeded in the greenhouse in December or January and the plants are set in the field in early spring, the bulbs mature in June, July, or later, depending on the district. Seedlings are grown extensively in the South for shipping north for planting in home and market gardens. The bulbs attain a diameter of 3 to 3½ inches when grown under irrigation in the South and Southwest. The bulbs are flat and have very few thin, shiny, pale-yellow scales that are soon broken and lost in handling. The flesh is soft and very mild in flavor.

Intermediate Varieties

Calred.—This variety was developed and introduced by the California Agricultural Experiment Station and the United States Department of Agriculture in 1947. It is an intermediate variety, the bulbs maturing at about the same time as those of Early Grano. It is adapted to the same production areas as Early Grano. Calred is highly non-bolting. The seedstalks are highly resistant and the foliage is moderately resistant to the race of onion downy mildew present in central California. The bulbs are deep-flat and almost black red, with outer scales a little lighter in color. The flavor is mild.

Early Grano (Babosa).—This variety, introduced by the New Mexico Agricultural Experiment Station, is adapted to the South and Southwest, where it is grown as a winter crop, and to the North, where plants are set in early spring. It is too late maturing for the very early producing districts of the South. It is somewhat resistant to damage by thrips, but very susceptible to injury by the pink root fungus. Early Grano bolts much less readily than Yellow Bermuda and Crystal Wax in Texas when planted at the same time, and it is a heavier yielder. Under irrigation in Texas and in the Southwest the bulbs of Early Grano mature at about the same time as those of Yellow Bermuda and reach a diameter of 2½ to 3 inches or more. The bulbs are round to top-shaped and have very few thin to medium-thick, pale-yellow scales that are soon broken and lost in handling. The flesh is soft and very mild in flavor.

Early Harvest.—This is an F_1 hybrid introduced in 1953 by the United States Department of Agriculture. It is a good extra-early hybrid for the North but rather widely adapted. Growth of this hybrid is very rapid in the early stages, but bulbing starts while the tops are still

rather small. Despite its early maturity it is very productive. The bulbs are high-globe in shape, as shown in figure 20.

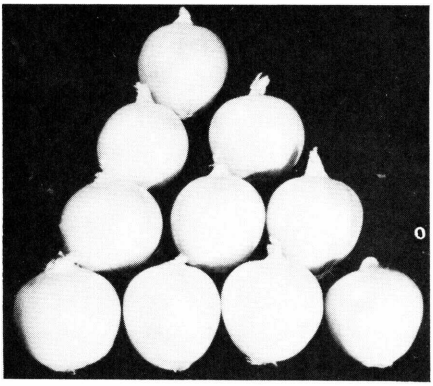

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Figure 20.—Early Harvest, a widely adapted early-maturing F_1 hybrid.

The outer dry scales are a light-straw color, few in number, and thin. The dry scales will adhere better if the bulbs are harvested slightly immature. The flesh is soft and intermediate in pungency. It is not a storage-type onion.

Italian Red.—This variety is very productive and is adapted to central California as a late-intermediate crop for immediate local consumption. It is not adapted to the Southern States, because it requires long daylight for bulb formation. It also cannot be grown in the humid areas, because it is extremely susceptible to various bulb rots. Italian Red is highly nonbolting. In central California, when the seed is sown in late August or early September and the seedlings are set in the field in November or December, the bulbs usually mature in late July. As most of the bulb forms above the soil level, Italian Red can be grown on heavier soil types than other varieties. The mature bulbs are torpedo- or long oval-shaped and may reach a diameter of 2½ to 3 inches. The medium-thick, purplish-red, dry scales are soon broken and lost in handling. Of the varieties described in this bulletin, Italian Red has the shortest storage life. It is highly esteemed for salad and garnish purposes because of its attractive color and very mild and sweet flavor.

Red 21 (California Early Red).—This variety, developed from California Early Red, was introduced by the California Agricultural Experiment Station. It is grown chiefly for the intermediate crop in central California, where the bulbs attain very large size, most of them being 3 to 3½ inches in diameter. The bulbs are uniform in size, shape, color, and time of maturity, and flat to medium-oblate in shape. The scale color is red, and the flesh is pink. The degree of color varies somewhat with the district, being much more intense when the onions are grown and matured under low temperature conditions. The flesh is soft and very mild and sweet in flavor.

San Joaquin.—This variety was developed and introduced cooperatively by the California Agricultural Experiment Station and the United States Department of Agriculture. Tests to date show that it grows well in Riverside County and in the San Joaquin Valley of California and in southern Utah. It is highly nonbolting. The bulbs mature slightly later than those of Crystal Wax. San Joaquin is a large yellow globe onion. The flesh is mild in flavor.

Stockton G36.—This is a strain of Stockton Yellow Globe introduced by the California Agricultural Experiment Station. It is especially well adapted for the intermediate crop in the central coastal district of California. It is highly nonbolting. The bulbs mature 10 to 14 days later than those of Red 21. Bulbs of Stockton G36 are yellow, slightly conical, with the top somewhat flattened, and they are mild in flavor.

Stockton Yellow Globe.—This variety is the one grown most extensively at present for the intermediate crop in central California. Stockton Yellow Globe is a heavy-yielding yellow onion that is mild in flavor. The shape is somewhat variable but mostly high flat to globe.

Late Varieties

Sweet Spanish.—This variety is best adapted to the Mountain States and California, where the crop can be grown under irrigation and under fairly dry atmospheric conditions. It also does well as a transplant crop in the North when seed is sown in the greenhouse in late December or in January or when southern-grown plants are used. Being a late-maturing variety, it is usually harvested in the North in late August or early September. It is somewhat resistant to thrips, and under humid conditions it is very susceptible to purple blotch. The yellow bulbs are globe-shaped but vary from deep oblate to slightly oval and attain a diameter of 3 to 3½ inches. Because of its succulent, sweet, mild-flavored, almost white flesh, sweet Spanish is greatly esteemed in salads.

White Sweet Spanish.—This variety is similar to Sweet Spanish except that it has an attractive white color. It is grown to some extent in the North as a trans-

plant crop from seed started in the greenhouse and from transplants grown in the South.

VARIETAL ADAPTATION

Most varieties of onions are limited in their range of adaptation. A variety may do well in one district and be worthless in another. It is essential therefore for the grower to have a knowledge of the different varieties so that he can choose those best suited to his particular conditions. New varieties should be tested on a rather limited scale until they have been shown definitely to be adapted to the district.

The varieties grown in the United States for transplant purposes differ in size, shape, color of bulb, bolting habit, pungency, keeping quality, time of maturity, and tolerance to diseases, insects, sunscald, and high and low temperatures. No one variety is suited to all conditions and suitable for all purposes. The adaptation of varieties to certain districts is determined largely by the conditions that affect bulbing, chiefly temperature and length of day. The number of hours of daylight necessary to cause bulbing varies with the different varieties, but it is affected by temperature. At favorable lengths of day, temperatures below 60° F. may inhibit bulb formation, whereas temperatures above 70° accelerate it. The attainment of maturity requires a longer day than does the start of bulb formation. In other words, a certain day length may cause a variety to start bulbing, but a still longer day is required for the bulb to develop and to mature properly.

Other factors for growth are the size and the age of the plant when temperature and day length are right for bulbing. Late planting somewhat delays the date of maturity. If seed and transplants are planted at the same time, the transplants will mature first. Also bulbs in thick plantings mature more quickly than those in thin plantings. Any increase in temperature or length of day will hasten maturity. Because of the low temperatures plants grown at high altitudes mature later than those at lower altitudes.

Late-maturing varieties of onions usually do poorly in the South. They may start to form bulbs, but the necks remain thick and never ripen properly. The length of day for initiation of bulbing of certain storage types is reached about April 20 at Crystal City, Tex.; for other varieties the daylight is never long enough.

In the North it is almost impossible to obtain good yields of the extra-early varieties, such as Excel and Texas Early Grano 502, by sowing seed directly in the field, because seeding is usually done at a date when the length of day is so long that the bulbing of these varieties is very rapid. After a few weeks, temperatures are also high enough for rapid bulbing; consequently, the plants develop only a few leaves and small bulbs. To obtain large bulbs of the extra-early varieties in the North, it is necessary to set well-developed transplants in the field as early in the spring as possible so that a large plant will develop before bulbing starts.

The Red Creole variety does not seem to be able to form bulbs of commercial size in the North even when large seedlings are transplanted to the field in early spring.

In central California a considerable acreage of the so-called intermediate crop of onions is grown. Seed is usually sown in field beds in late August or early September and the seedlings are transplanted in late November and in December. During the winter and early spring the plants usually make a large vegetative development, but bulbing

does not begin until the temperature and length of day are right. If the early varieties of the South or the late storage types of the North are used, they make good vegetative growth; but in the spring many of the plants form seedstalks, instead of bulbs. Therefore, varieties such as Stockton Yellow Globe, Red 21, and Italian Red, which do not have a tendency to bolt readily, may be used.

Not only is it important to use varieties that are adapted to the district, but for best results it is essential that good strains of the respective varieties be obtained. It is not uncommon for a grower to lose practically his entire crop when seed of poor quality is planted.

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